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Smoking Outcome Expectancies: Factor Structure, Predictive Validity, and Discriminant Validity

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Recent models of addiction posit that drug outcome expectancies are influential determinants of drug use. The current research examines the dimensional structure, predictive validity, and discriminant validity of expectancies for cigarette smoking in a prospective study. There was a good fit between the factor structure of the Smoking Consequences Questionnaire and the observed data. In addition, the internal consistency of each scale was satisfactory. Moreover, there was considerable evidence for the predictive and discriminant validity of expectancies. Expectancies of positive outcomes (positive reinforcement, negative reinforcement, and appetite–weight control) predicted withdrawal severity. Negative reinforcement expectancies and expectancies of negative consequences predicted cessation success. Predictive relations remained significant after controlling for related constructs: negative affect, stress, and dependence measures.

Many recent models of addiction, particularly those from a cognitive or social learning perspective, have proposed that drug outcome expectancies are influential determinants of drug motivation and use (Abrams & Niaura, 1987; Baker, Morse, & Sherman, 1987; Cooper, Russell, & George, 1988; Cooper, Russell, Skinner, Frone, & Mudar, 1992; Cox & Klinger, 1988; Goldman, Brown, & Christiansen, 1987; Marlatt & Gordon, 1985; Niaura, Goldstein, & Abrams, 1991; Niaura et al., 1988). The role of expectancies as causal agents of drug use has been strengthened by recent longitudinal research demonstrating that expectancies predict later alcohol use (Christiansen, Smith, Roehling, & Goldman, 1989) even after controlling for previous use (Stacy, Newcomb, & Bentler, 1991). These findings are incongruent with theories suggesting that expectancies are simply the consequence of previous drug use rather than causal factors that influence consumption (Vuchinich & Tucker, 1988).

Most of the research on drug outcome expectancies has focused on the expected consequences of alcohol use. Although alcohol expectancies have been found to discriminate between categories of drinkers, to predict future drinking, and to be associated with quantity/frequency measures of alcohol use (for reviews, see Goldman et al., 1987; Leigh, 1989b; Leigh & Stacy, 1991), basic, unresolved issues remain. In particular, significant disagreement exists regarding the dimensional structure and discriminant validity of alcohol/drug expectancies (Goldman, Brown, Christiansen, & Smith, 1991; Leigh, 1989b; Leigh & Stacy, 1991). Moreover, there are few data that examine expectancies as predictors of drug withdrawal or cessation success despite a substantial amount of theory proposing that expectancies play a causal role (Abrams & Niaura, 1987; Marlatt & Gordon, 1985; Niaura et al., 1988). The present research addresses these issues by examining the factor structure, predictive validity, and discriminant validity of outcome expectancies for cigarette smoking in a sample of adult smokers who participated in clinical trials of a transdermal nicotine replacement system.

Factor Structure of Expectancies

Confirmatory factor analysis has indicated that several measures of alcohol expectancies, including the most widely used expectancy instrument, the Alcohol Expectancy Questionnaire (AEQ; Brown, Goldman, Inn, & Anderson, 1980), have poorly fitting factor structures (Leigh, 1989a). Leigh (1989b) argued that many items on the AEQ load heavily on the first, general factor (Cooper et al., 1988, 1992) and contended that the six AEQ scales (global positive changes, sexual enhancement, social and physical pleasure, increased assertiveness, tension reduction, and power) may actually be measuring a single general construct rather than distinct expectancy dimensions. However, other evidence suggests that separate expectancy factors representing the positive consequences and the negative consequences of alcohol use may be reliably discriminable in terms of some of their empiric relations (Stacy, Widaman, & Marlatt, 1990).

Several models of drug motivation (Baker et al., 1987; Cox & Klinger, 1988; Niaura et al., 1988, 1991; Wise, 1988) suggest a dimensional structure more complex than that represented by

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either a single general factor or a two-factor model. These theories typically propose that the positive consequences of drug use encompass at least two major dimensions: positive reinforcement (positive affect enhancement, social skill facilitation, etc.) and negative reinforcement (tension reduction, relief from withdrawal, etc.). Thus, if expectancy dimensions reflect the motivational factors proposed by theory, the factor structure of the positive consequences of drug use may prove to be multifactorial. Consistent with a multifactorial structure, recent research has suggested that specific positive outcome expectancy dimensions may predict alcohol use independently of a global positive factor (Leigh & Stacy, 1993). The expected negative consequences of drug use may be multifactorial as well. For instance, the negative consequences of smoking may be best represented by factors reflecting the short-term and long-term effects or the social and nonsocial consequences of smoking. More research is needed, however, to identify the most appropriate dimensional structure of drug outcome expectancies and the variability of these structures across drugs.

Smoking Outcome Expectancies

In comparison with the literature on alcohol expectancies, there are few studies that have examined the factor structure of smoking outcome expectancies (Bauman & Chenoweth, 1984; Brandon & Baker, 1991; Velicer, DiClemente, Rossi, & Prochaska, 1990), although beliefs or attitudes about smoking have been studied (Costa, McCrae, & Bosse, 1980; Ikard, Green, & Horn, 1969). Bauman and Chenoweth (1984) found six smoking expectancy factors in a study of adolescents: Negative Physical/Social, Positive Peer Relationships, Negative Peer Relationships, Habit, Health, and Pleasure. Smoking initiation was predicted by both the Negative Physical/Social and Pleasure scales, and increased smoking was predicted by Pleasure. Although smoking outcome expectancies predicted initiation and amount of smoking in adolescents, the specific factors that regulate the maintenance and cessation of smoking may be different from those that affect initiation. In addition, the overall factor structure of expectancies may be different among older, more dependent smokers.

The instrument used in our research, the Smoking Consequences Questionnaire (SCQ; Brandon & Baker, 1991), was developed using a subjective expected utility (SEU) approach in which smoking expectancy items were rated with respect to both their likelihood of occurring and their desirability. Items were based on the clinical reports of smokers, on research on smoking motivation, and on previous scales assessing smoking motivation (Brandon & Baker, 1991). A principal-components analysis of the SCQ used responses from college-age current smokers and exsmokers and yielded four interpretable factors: Negative Consequences, Positive Reinforcement, Negative Reinforcement, and Appetite–Weight Control (Brandon & Baker, 1991). Among college students, daily smokers held stronger expectancies of Positive Reinforcement and Negative Reinforcement than did occasional smokers, exsmokers, triers, and never smokers.

The factor structure of the SCQ appears to agree with considerable recent research pointing to two major types of drug reinforcement: positive reinforcement, or positive affect enhancement, and negative reinforcement, or negative affect reduction (see Baker et al., 1987; Niaura et al., 1988; U.S. Department of Health and Human Services, 1988; Wise, 1988). In congruence with the SCQ findings and with theory, other investigators have found factors consistent with positive reinforcement and negative reinforcement among adult smokers (Velicer et al., 1990). Moreover, the Negative Consequences scale of the SCQ concerns the negative effects of smoking, many of which appear to serve as motivators for quit attempts (cancer, heart disease, cough, social disapproval, addiction, etc.; Pechacek, 1979; U.S. Department of Health and Human Services, 1989). The Appetite–Weight Control scale reflects the fact that many smokers initiate or continue smoking because of its perceived impact on hunger and weight (Camp, Klesges, & Relyea, 1993; Klesges et al., 1988). Despite the congruence of the SCQ scales with theory and empirical observations, it is important to examine the validity of the factor structure of the SCQ in a population of dependent adult smokers, as well as determine whether these scales have predictive and discriminant validity with respect to important smoking outcomes.

Predictive and Discriminant Validity of Expectancies

Predicting Concurrent Smoking Measures

Previous research with college-age subjects shows that regular smokers have higher reinforcement expectancies than do nonsmokers or infrequent smokers (Brandon & Baker, 1991). It is unclear whether expectancies are related to smoking patterns among older, more dependent smokers. Restriction of range might limit these associations because the great majority of such smokers generates high expectancy values and high self-administration/dependence scores. Among addicted smokers, smoking rate and blood nicotine/cotinine levels may reflect the influence of factors such as automaticity (Tiffany, 1990) that may be largely independent of expectancies of reinforcement likelihood.

Predicting Withdrawal and Relapse

Although smoking expectancies may or may not be associated with daily smoking patterns in dependent adult smokers, there is reason to believe that expectancies are related to withdrawal syndrome severity and cessation success even in a population of heavily dependent smokers. For instance, those smokers with the greatest expectancies of positive reinforcement from smoking might experience the greatest reinforcement loss when they quit. Reinforcement loss, in turn, might predict withdrawal severity (Falk, 1981), or those smokers with the highest expectancies of negative reinforcement might have the greatest urge to smoke (a withdrawal measure) once they quit (Wetter, Brandon, & Baker, 1992).

Expectancies should also be related to cessation success (Cox & Klinger, 1988; Niaura et al., 1988). To the extent that a smoker has more positive expectancies about the consequences of smoking, it is more likely that he or she will be unable to quit smoking or will relapse to tobacco use. Negative reinforcement expectancies may be more powerful predictors of quitting success than are other positive outcome expectancies because negative affect appears to be a common setting event for postcessation smoking (Brandon, Tiffany, Obremski, & Baker, 1990;

O'Connell & Martin, 1987; Shiffman, 1982, 1984). Data on alcohol expectancies support such a prediction (Brown, 1985; Rather & Sherman, 1989). Expectancies of negative consequences should also predict cessation success; that is, individuals may refrain from smoking if they expect to develop heart disease or lung cancer if they smoke (Pechacek, 1979; U.S. Department of Health and Human Services, 1989).

Study Purpose

The current research examined the psychometric properties of the SCQ and attempted to cross-validate its factor structure in a sample of adult smokers. Confirmatory factor analysis was used to test four alternative models. Second, specific expectancy scales were used to predict withdrawal symptomatology and cessation success in a prospective study involving multiple sites. To show that expectancies contribute unique information, their predictive validity was examined after effects attributable to related constructs (dependence, negative affect, and stress) were statistically controlled. In addition, the unique contribution of each expectancy scale in relation to the other expectancy scales in predicting cessation success was determined to examine discriminant validity. We examined outcome expectancies for cigarette smoking to continue recent efforts to broaden the scope of expectancy research beyond alcohol use (Bauman & Chenoweth, 1984; Brandon & Baker, 1991; Shadel & Mermelstein, 1993; Stacy et al., 1991; Velicer et al., 1990).

Method

Subjects

Subjects were smokers who participated in three clinical trials examining the efficacy of the nicotine patch in aiding smoking cessation. The total sample (N = 632) comprised 280 subjects from four sites who participated in the first trial, 112 subjects from a single site who participated in a second trial, and 240 subjects from three sites who participated in a third trial. All trials were randomized, double-blind studies in which half of the subjects received active nicotine patches, and half received placebo patches. In the first trial, participants received 8 weeks of both 22-mg nicotine patch therapy (or placebo patches) and weekly group counseling sessions of approximately 1 hr in length. In the second trial, participants received 6 weeks of nicotine patch therapy (or placebo) consisting of 4 weeks of 22-mg nicotine patch therapy followed by 2 weeks of 11-mg nicotine patch therapy. Subjects in the third trial received 8 weeks of 22-mg nicotine patch therapy (or placebo). Subjects in both the second and third trials received brief individual counseling sessions that occurred on a weekly basis for a total of 8 weeks.

All subjects were selected according to identical inclusion and exclusion criteria. Inclusion criteria were age 21 to 65 years, a history of smoking 15 or more cigarettes per day during the past year, an expired air carbon monoxide (CO) level of 10 parts per million (ppm) or greater, and motivation to quit smoking. Exclusion criteria were presence of cardiovascular disease, pregnancy or lactation, regular use of psychotropic drugs, current symptomatic psychiatric disorder, current alcohol or drug abuse, chronic dermatologic disorders, and use of any experimental medication during the past 30 days.

The mean age of the total sample was 42.6 years (SD = 10.1), and 61.0% of the subjects were women. Means and standard deviations (in parentheses) for smoking characteristics were as follows: cigarettes smoked per day = 29.6 (10.4); years smoked = 24.2 (9.9); Fagerstrom Tolerance Questionnaire scores = 7.0 (1.8); and CO level = 30.6 (13.7). Therefore, our sample consisted primarily of long-term, dependent smokers.

Subject Pooling and Attrition

Subject attrition at each individual site for all three clinical trials was examined to identify any sites with excessive subject loss before the end of patch treatment. Attrition equal to or greater than 50% was considered excessive; any sites meeting this exclusion criterion were eliminated from analyses involving intratreatment variables. Using this criterion, we identified two sites from the first trial in which attrition was 71.4% and 53.5% by the end of patch treatment. For the remaining six sites, attrition ranged from 11.7% to 39.4%. All sites were used for analyses involving only baseline (pretreatment) measures, that is, prior to attrition.

Measures

Baseline measures. Prior to beginning the treatment phase of each trial, the following data were collected: serum samples for nicotine and cotinine testing; expired CO level; and self-report measures of nicotine dependence, affect, stress, expectancies, and demographics. Dependence was measured using the Fagerstrom Tolerance Questionnaire (Fagerstrom, 1978). Negative affect and perceived stress during the previous week were measured using the Positive and Negative Affect Scale (PANAS; Watson, Clark, & Tellegen, 1988) and the Perceived Stress Scale (PSS; S. Cohen, Kamarck, & Mermelstein, 1983).

Smoking outcome expectancies were measured using the SCQ described earlier (Brandon & Baker, 1991). Items were rated on a 0 to 9 scale with respect to the likelihood of occurrence of each consequence. Desirability ratings were not assessed because of time constraints and because previous research indicated that they provided no predictive power over and above likelihood ratings alone (Brandon & Baker, 1991).

Withdrawal, negative affect, and perceived stress measures. On the basis of previous studies of tobacco withdrawal (Hughes & Hatsukami, 1986), eight withdrawal symptoms were assessed: anger, anxiety, number of awakenings, concentration difficulty, depression, hunger, impatience, and urge. Each symptom was assessed by a single item rated on a scale of 0 (not present) to 4 (severe) on a "diary" that subjects completed every day. Ratings were collapsed across Days 2 through 8 after quitting (Week 1) to yield a single mean score for each symptom. Also, a withdrawal index was formed that was a composite of the eight individual symptoms. The quit day was not included because patch treatment did not start until the second day of quitting. Thus, Days 2–8 comprised subjects' first 7 days on patch.

The effect of withdrawal on negative affect and perceived stress was also assessed. On the eighth day after quitting (Week 1), subjects rated their negative affect and perceived stress during the preceding week using the PANAS and PSS.

Cessation success measures. A point-prevalence measure of cessation success was used, defined as a self-report of no smoking during the previous 7 days and a CO level of less than 10 ppm. Abstinence was assessed on the eighth day after quitting (Week 1) and at the end of patch treatment (the eighth week after quitting for Study 1 and Study 3 subjects, and the sixth week after quitting for Study 2 subjects). Subjects with missing data for smoking status or CO were assumed to have smoked and were classified as smokers.

Data Analyses

Data analysis was conducted in four stages. First, the factor structure of the SCQ, the internal consistency of the individual scales, and the intercorrelations among the scales were assessed. Second, the relations among expectancy scales and baseline measures of affect, stress, and smoking were examined. Third, the associations between expectancy scales and measures of withdrawal during the first week after quitting

were examined. Finally, expectancy scale scores were used to predict cessation success 1 week after quitting and at the end of patch treatment.

Results

Confirmatory Factor Analysis, Internal Consistency, and Scale Intercorrelations

Confirmatory factor analysis (CFA) was used to test four alternative models: (a) a single-factor model; (b) a two-factor model with dimensions comprising the positive consequences (the SCQ scales of Positive Reinforcement, Negative Reinforcement, and Appetite–Weight Control) and negative consequences (the SCQ scale of Negative Consequences); (c) a three-factor model with dimensions representing reinforcement (Positive Reinforcement and Negative Reinforcement), negative consequences (Negative Consequences), and appetite–weight control (Appetite–Weight Control); and (d) a four-factor model based on the original factor structure of the SCQ (Brandon & Baker, 1991). Three indicator variables were constructed for each of the original SCQ factors. Individual items from a particular scale were randomly assigned to one of three indicators specific to that factor such that each indicator consisted of either a single questionnaire item or parcels of items representing the mean value of 2 or more questionnaire items. In other words, the 18 items on the Negative Consequences scale were randomly assigned to three indicators specific to that scale, the 15 Positive Reinforcement items were randomly assigned to three indicators specific to that scale, the 12 Negative Reinforcement items were randomly assigned to three indicators specific to that scale, and the 5 Appetite–Weight Control items were randomly assigned to three indicators specific to that scale. Items were randomly assigned to factor indicators because we believed that we lacked sufficient empirical justification for creating theoretically distinct subfactors within the hypothesized factors. Thus, a total of 12 indicators (3 indicators × 4 factors) were used in the CFA analyses.[1] In each model, all the indicators from a particular scale were constrained to load on a single factor, and factor variances were set to 1.0.

It has been suggested that the most reliable evidence for a model's goodness of fit is consistency across multiple indices (Mulaik et al., 1989). Therefore, several goodness-of-fit indices are presented for each analysis: the chi-square test; the Normed Fit Index (NFI; Bentler & Bonett, 1980); the Comparative Fit Index (CFI; Bentler, 1989); the standardized root-mean-square residual (RMR); and the Tucker-Lewis Index (TLI; Tucker & Lewis, 1973). A nonsignificant chi-square test indicates that the observed data are consistent with the specified model. However, the chi-square test is sensitive to sample size, and plausible models may be rejected when tested with large sample sizes. The improvement in fit of one model over another can be measured by the difference between two chi-square statistics. The larger the reduction in chi-square, the greater the improvement. NFI and CFI values range from 0 to 1 with larger values indicating a better fit. Values greater than .90 indicate a good fit of the observed data to the specified model (Bentler & Bonett, 1980). For the RMR, smaller values indicate a better fit, with values of .10 or less indicating a good fit. The TLI was calculated such that each target model was compared to a less factorially complex model, that is, the one-factor model served as the null model for the two-factor model, the two-factor model served as the null model for the three-factor model, and the three-factor model served as the null model for the four-factor model. Therefore, values of the TLI are smaller than those of the NFI and CFI because each target model is compared to a more plausible null model.

Table 1
Goodness-of-Fit Information for Alternative Factor Models

Model	Chi-square	*df*	NFI	CFI	RMR	TLI
1-factor	2,798	54	.47	.47	.19	—
2-factor	2,208	53	.58	.59	.15	.20
3-factor	720	51	.86	.87	.08	.68
4-factor	160	48	.97	.98	.04	.82

Note. NFI = Bentler-Bonett normed-fit index. CFI = comparative fit index. RMR = standardized root-mean-square residual. TLI = Tucker–Lewis index. As described in the text, factor indicators consisted of either a single questionnaire item or parcels of items representing the mean value of two or more questionnaire items. The chi-square test statistic was significant for all models. $N = 568$.

Results of the confirmatory factor analyses are presented in Table 1. As indicated by all of the fit indices, the original Brandon and Baker (1991) four-factor model fit the observed data very well and provided a better fit than did any of the alternative models. Consistent with these indices, the chi-square difference test indicated that the four-factor model fit the data better than did the three-factor model (Model 3 − Model 4; change in $\chi^2[3, N = 568] = 560$), which fit the data better than did the two-factor model (Model 2 − Model 3; change in $\chi^2[2, N = 568] = 1{,}488$), which fit the data better than did the one-factor model (Model 1 − Model 2; change in $\chi^2[1, N = 568] = 590$). On the basis of these results, the original four-factor structure was retained for all further analyses.

Internal consistency was satisfactory for all scales in the original four-factor model (Table 2). In addition, all the expectancy scales were significantly and positively intercorrelated (Table 2).

Expectancy Scales and Baseline Measures

Gender differences emerged on three of the four expectancy scales with women expecting more Negative Reinforcement (5.5 vs. 4.9; $t[584] = 3.6$, $p < .001$), Appetite–Weight Control (4.6 vs. 3.6; $t[586] = 5.1$, $p < .001$), and Negative Consequences

[1] We are grateful to an anonymous reviewer who suggested that we reduce the number of indicator variables by constructing indicators for each factor by parcelling rather than using each individual questionnaire item as an indicator. Our fit indices improved substantially when adopting this strategy (as presented in Table 1). Initial fit indices for the four-factor model when using all 50 questionnaire items as indicators were Normed Fit Index = .66, Comparative Fit Index = .71, and standardized root-mean-square residual = .12. Possible reasons for the improvement in fit when using parcels of items as indicators rather than individual items include the following: Reducing the number of indicators by parcelling reduces the probability of chance covariances among indicators; single items are measured with more random error than are parcels of items; and parcelling can reduce the effects of systematic error such as covariances between the method variances of items on different factors that share structure or wording but not meaningful content.

Table 2
SCQ Expectancy Scale Intercorrelations and Coefficient Alpha Reliabilities

SCQ Scale	Positive Reinforcement	Negative Reinforcement	Appetite–Weight Control	Negative Consequences
Positive Reinforcement	.86	.58	.33	.18
Negative Reinforcement		.93	.39	.24
Appetite–Weight Control			.95	.15
Negative Consequences				.83

Note. SCQ = Smoking Consequences Questionnaire. Values on the diagonal are coefficient alpha reliabilities. $N = 568$. All correlations are significant at $p < .001$.

(6.9 vs. 6.5, $t[582] = 4.5$, $p < .001$) than did men. Zero-order correlations indicated that expectancies were not associated with age.

Expectancies were largely unrelated to traditional measures of nicotine dependence such as cigarettes per day, Fagerstrom score, CO, serum nicotine, and serum cotinine (Table 3). Although Positive Reinforcement was associated with Fagerstrom score and CO level, and Negative Consequences was inversely associated with serum nicotine, these correlations were small (*r*s from −.12 to .14), and there was little evidence of a consistent relationship between a specific expectancy scale and measures of dependence. All of the expectancy scales were positively related to both Negative Affect and Perceived Stress (Table 3).

Predicting Withdrawal, Negative Affect, and Stress After Quitting

Withdrawal. Since smoking after the quit day may affect withdrawal ratings (Fiore et al., 1994), only abstinent subjects were used in analyses examining the relations between baseline expectancies and postcessation measures of withdrawal, negative affect, and perceived stress. Partial correlations of expectancies with withdrawal symptomatology after partialling out the effects of age, gender, counseling format, patch status, cigarettes per day, CO, Fagerstrom score, serum nicotine, and serum cotinine are presented in the top half of Table 4. Partial correlations of expectancies with withdrawal symptomatology after partialling out the above effects as well as the effects of negative affect and perceived stress are presented in the bottom half of Table 4. The use of a partial correlation analysis is a conservative strategy that assesses the predictive validity of expectancies over and above that provided by measures of nicotine dependence, negative affect, and stress.

Positive Reinforcement, Negative Reinforcement, and Appetite–Weight Control predicted both the composite withdrawal index and virtually all of the individual symptoms of withdrawal (Table 4, top). Negative Consequences was unrelated to withdrawal symptomatology. Examination of zero-order correlations (not shown) indicated that the strength of the associations among expectancies and withdrawal symptomatology were largely unaffected by the partialling of demographic, treatment, and dependence variables; that is, zero-order and partial correlation coefficients were virtually identical for most associations. As shown in the bottom half of Table 4, the magnitude of the correlations among expectancies and withdrawal items was reduced after controlling for the effects of baseline negative affect and perceived stress in addition to demographic, treatment, and dependence variables. However, positive outcome expectancies (Positive Reinforcement, Negative Reinforcement, and Appetite–Weight Control) continued to predict the withdrawal index and a substantial number of individual symptoms of withdrawal.

Negative affect and perceived stress. All of the positive outcome expectancy scales (Positive Reinforcement, Negative Reinforcement, and Appetite–Weight Control) were related to Week 1 negative affect and perceived stress among abstinent smokers after partialling out baseline measures of demographics, treatment, and nicotine dependence (Table 5, top). Negative Consequences was predictive of Week 1 perceived stress. Again, there was little redundancy with demographic, treatment, or dependence measures because the zero-order correlations between expectancies and Week 1 Negative Affect and Perceived Stress were very similar to those presented in the top half of Table 5.

Positive Reinforcement expectancies and Negative Rein-

Table 3
Correlations of SCQ Expectancy Scales With Baseline Measures

Expectancy scales	Cigarettes per day	Fagerstrom	CO	Serum nicotine	Serum cotinine	Negative affect	Perceived stress
Positive Reinforcement	.08	.14**	.11**	.00	.03	.13**	.10*
Negative Reinforcement	−.06	.03	.04	−.01	.01	.30***	.33***
Appetite–Weight Control	−.05	−.02	.06	−.04	−.05	.12**	.12**
Negative Consequences	.03	.05	.00	−.12**	−.06	.15***	.09*

Note. SCQ = Smoking Consequences Questionnaire. CO = Carbon monoxide level. Fagerstrom = Fagerstrom Tolerance Questionnaire. *N* ranges from 557 to 586.
* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 4
Partial Correlations of SCQ Expectancy Scales With Withdrawal Symptoms in Abstinent Subjects

Expectancy scales	Withdrawal Index	Anger	Anxiety	Number of awakenings	Difficulty concentrating	Depression	Hunger	Impatience	Urge
Controlling for demographic, treatment, and dependence measures									
Positive Reinforcement	.40***	.38***	.37***	.15	.35***	.28***	.20**	.36***	.26**
Negative Reinforcement	.37***	.39***	.35***	.17*	.33***	.33***	.11	.34***	.19*
Appetite–Weight Control	.27***	.22**	.25**	.08	.26**	.22**	.17*	.26**	.13
Negative Consequencees	.08	.08	.11	−.04	.09	.03	.10	.09	.00
Controlling for demographic, treatment, dependence, negative affect, and stress measures									
Positive Reinforcement	.35***	.33***	.32***	.10	.29***	.22**	.18*	.31***	.23**
Negative Reinforcement	.24**	.27***	.22**	.08	.21**	.22**	.07	.21**	.10
Appetite–Weight Control	.21**	.16*	.19*	.03	.21**	.16*	.15	.19*	.08
Negative Consequences	.00	.01	.04	−.08	.03	−.04	.08	.02	−.05

Note. The Withdrawal Index is a composite of all the individual withdrawal items. The partial correlation coefficients in the top half of the table reflect the relations after partialling out the following: demographics (age and sex), treatment (counseling type and patch status), and baseline measures of nicotine dependence (number of cigarettes per day, Fagerstrom score, CO level, serum nicotine level, and serum cotinine level). The partial correlation coefficients in the bottom half of the table control for the identical variables as well as baseline negative affect and perceived stress (Positive and Negative Affect Scale—Negative Affect and Perceived Stress Scale). SCQ = Smoking Consequences Questionnaire. *N* ranges from 161 to 166.
* $p < .05$. ** $p < .01$. *** $p < .001$.

forcement expectancies continued to predict Week 1 negative affect and Week 1 perceived stress after controlling for baseline negative affect and perceived stress in addition to demographics, treatment, and dependence (Table 5, bottom). The magnitude of the associations was somewhat diminished, however. Still, expectancies accounted for unique variance in postcessation negative affect and perceived stress over and above that accounted for by demographics, treatment, nicotine dependence, and baseline measures of the dependent variables themselves.

Table 5
Partial Correlations of Expectancy Scales With Week 1 Negative Affect and Perceived Stress in Abstinent Subjects

Expectancy scales	Negative affect	Perceived stress
Controlling for demographic, treatment, and dependence measures		
Positive Reinforcement	.34***	.36***
Negative Reinforcement	.37***	.48***
Appetite–Weight Control	.19*	.24**
Negative Consequences	.12	.22**
Controlling for demographic, treatment, dependence, negative affect, and stress measures		
Positive Reinforcement	.32***	.28***
Negative Reinforcement	.30***	.29***
Appetite–Weight Control	.13	.20*
Negative Consequences	.08	.10

Note. The partial correlation coefficients in the top half of the table reflect the relations after partialling out the following: demographics (age and sex), treatment (counseling type and patch status), and baseline measures of nicotine dependence (number of cigarettes per day, Fagerstrom score, CO level, serum nicotine level, and serum cotinine level). The partial correlation coefficients in the bottom half of the table control for the identical variables as well as baseline negative affect and perceived stress (Positive and Negative Affect Scale—Negative Affect and Perceived Stress Scale). *N* ranges from 163 to 170.
* $p < .05$. ** $p < .01$. *** $p < .001$.

Predicting Cessation Success

Multivariate logistic regression analyses were used to predict cessation success both at 8 days after quitting (Week 1) and at the end of patch treatment (end of treatment). Cessation success was a dichotomous variable, defined as a self-report of no smoking during the previous 7 days and a CO level of less than 10 ppm. Two analyses were done for each point in time. In the first analysis, demographics (age and gender) and treatment variables (counseling format and patch status) were entered into the equation as the first step. Baseline dependence measures (Fagerstrom score, cigarettes per day, CO, serum nicotine, and serum cotinine) were entered as the second step. The expectancy scales were entered as a set in the third step. In the second analysis, the first (demographics and treatment) and second steps (dependence) were identical to those of the first analysis. As the third step, baseline negative affect and perceived stress were entered, followed by the set of expectancy scales as the fourth step.

As with the withdrawal analyses, this is a conservative analytic strategy. Not only are expectancy scales forced to be unique predictors after controlling for all variables entered on previous steps in the equation, but they must be unique predictors after controlling for other variables entered on the same step; that is, each expectancy scale must predict cessation success after controlling for the effects of the other expectancy scales in addition to demographic, treatment, and dependence measures. This strategy provides a stringent test of the discriminant and predictive validity of each expectancy scale.

For all analyses, the interaction terms were restricted to those two-way interactions that involved expectancies and had either been found in previous research or were of significant practical relevance. Therefore, the two-way interactions of each expectancy scale with gender (Cooper et al., 1992) and patch status were entered as the final step in all analyses (Step 4 for the first analyses and Step 5 for the second analyses; a total of 8 interaction terms). In addition, the two-way interactions of each expectancy scale with negative affect (McKirnan & Peterson,

Table 6
Logistic Regression Analyses Using Expectancy Scales to Predict Cessation Success After Controlling for Demographic, Treatment, and Dependence Measures

Predictor variables	Week 1 cessation success			End-of-treatment cessation success		
	Regression coefficient	Partial correlation coefficient	*p*	Regression coefficient	Partial correlation coefficient	*p*
		Step 1				
Age	.00	.00	.85	.01	.00	.19
Gender	.37	.05	.07	.74	.14	<.001
Patch status	1.04	.20	<.001	.98	.19	<.0001
Counseling	−.46	−.06	<.05	−.04	.00	.86
		Step 2				
CO	.01	.00	.26	.02	.04	.09
Cotinine	.00	.00	.52	.00	.00	.39
Nicotine	−.03	−.06	<.05	−.03	−.07	<.05
Cigarettes per day	.00	.00	.72	−.01	.00	.52
Fagerstrom	−.10	−.03	.12	−.06	.00	.40
		Step 3				
Positive Reinforcement	.00	.00	.51	.01	.00	.41
Negative Reinforcement	−.02	−.09	<.05	−.02	−.12	<.01
Appetite–Weight Control	.02	.04	.08	.02	.07	<.05
Negative Consequences	.02	.13	<.001	.01	.00	.32

Note. CO = carbon monoxide level. Fagerstrom = Fagerstrom Tolerance Questionnaire. All independent variables entered into the equation were assessed at baseline. Logistic regression analyses control for variables entered on the same step and previous steps. $N = 438$.

1988) and perceived stress (Cooper et al., 1992) were entered as part of the final step for those analyses that included these variables (Step 5 of the second analyses; an additional 8 interaction terms and a total of 16 terms). Results of the tests of interactions are not presented because the number of significant interactions did not exceed chance levels and because the entry of the set of interaction terms did not significantly improve the model fit in any of the four logistic regression analyses.

Table 6 presents the results of the cessation success analyses after controlling for demographic, treatment, and dependence variables. Regression coefficients (B), partial correlation coefficients (R), and *p* values reflect each variable's entry into the equation after controlling for all other variables on the same step and any preceding steps (J. Cohen & Cohen, 1983; Tabachnick & Fidell, 1989). Both Negative Reinforcement and Negative Consequences predicted Week 1 cessation success. Strong expectancies of negative reinforcement predicted a decreased likelihood of success, and strong expectancies regarding the negative consequences of smoking predicted an increased likelihood of success. In these models, active patch, individualized counseling, and lower baseline levels of serum nicotine were associated with greater cessation success at Week 1.

At the end of treatment, Negative Reinforcement continued to predict cessation success, but Negative Consequences did not (Table 6). Strong expectancies of negative reinforcement from smoking predicted a reduced likelihood of cessation success. In addition, Appetite–Weight Control predicted end-of-treatment cessation success, but the relationship was opposite of what was expected. Strong expectancies that smoking would control appetite and weight were related to an increased likelihood of cessation success. Active patch, male gender, and lower baseline levels of serum nicotine predicted greater cessation success.

Table 7 presents the results of cessation analyses controlling for baseline negative affect and perceived stress in addition to demographic, treatment, and dependence variables. Regression coefficients, partial correlation coefficients, and *p* values for control variables are slightly different in Tables 6 and 7 because of slight differences in the number of subjects included in the analyses. Negative Reinforcement and Negative Consequences continued to be significant predictors of Week 1 cessation success after controlling for baseline negative affect and stress. Perceived stress at baseline was a significant predictor of Week 1 cessation success such that an increased likelihood of success was predicted by decreased baseline stress levels. Negative Affect at baseline did not predict cessation success at Week 1.

Both Negative Reinforcement and Appetite–Weight Control expectancies predicted end-of-treatment cessation success after controlling for demographics, treatment, dependence, negative affect, and perceived stress (Table 7). The likelihood of successfully quitting smoking was decreased for subjects with strong negative reinforcement expectancies and increased for subjects with strong appetite–weight control expectancies.[2] Perceived

[2] It might be argued that the poor predictive power of Positive Reinforcement with respect to cessation success resulted from the fact that all the expectancy scales were entered as a set such that only each scale's unique predictive power is reflected in the regression coefficients; thatis, the predictive relations between a specific expectancy scale and ces-

Table 7
Logistic Regression Analyses Using SCQ Expectancy Scales to Predict Cessation Success After Controlling for Demographic, Treatment, Dependence, Negative Affect, and Perceived Stress Measures

Predictor variables	Week 1 cessation success			End of treatment cessation success		
	Regression coefficient	Partial correlation coefficient	*p*	Regression coefficient	Partial correlation coefficient	*p*
		Step 1				
Age	.00	.00	.78	.01	.00	.16
Gender	.36	.04	.08	.74	.14	<.001
Patch status	1.05	.20	<.0001	.94	.18	<.0001
Counseling	−.46	−.06	<.05	.03	.00	.90
		Step 2				
CO	.01	.00	.26	.02	.04	.10
Cotinine	.00	.00	.49	.00	.00	.33
Nicotine	−.03	−.06	.05	−.03	−.06	<.05
Cigarettes per day	.00	.00	.77	−.01	.00	.52
Fagerstrom	−.12	−.04	.08	−.06	.00	.40
		Step 3				
Negative affect	.14	.00	.43	.26	.00	.18
Perceived stress	−.40	−.06	<.05	−.65	−.13	<.01
		Step 4				
Positive Reinforcement	.00	.00	.72	.00	.00	.67
Negative Reinforcement	−.01	−.06	<.05	−.02	−.10	<.01
Appetite–Weight Control	.01	.02	.14	.02	.08	<.05
Negative Consequences	.02	.13	<.01	.00	.00	.42

Note. SCQ = Smoking Consequences Questionnaire. CO = carbon monoxide level. Fagerstrom = Fagerstrom Tolerance Questionnaire. All independent variables entered into the equation were assessed at baseline. Logistic regression analyses control for variables entered on the same step and previous steps. $N = 430$.

stress at baseline predicted end-of-treatment cessation success, but Negative Affect at baseline did not. Lower baseline levels of perceived stress were associated with an increased likelihood of success.

In an attempt to understand the relationship between Appetite–Weight Control expectancies and cessation success, models that included baseline body weight and weight gain during treatment were analyzed using logistic regression. All possible two-way and three-way interactions involving weight, weight gain, or both variables with gender, patch status, and Appetite–Weight Control expectancies were included in these models. These models were not informative in clarifying the relationship between Appetite–Weight Control expectancies and cessation success.

Discussion

The psychometric properties of the SCQ were quite satisfactory when tested in a sample of dependent adult smokers. Confirmatory factor analyses indicated that (a) there was a good fit between the original four-factor structure of the SCQ and the observed data and (b) the original four-factor structure fit the data better than did several plausible alternative models. Furthermore, the internal consistency of each of the SCQ expectancy scales was good.

There was considerable evidence for the predictive validity of expectancies. Expectancies predicted postcessation measures of negative affect, stress, withdrawal severity, and success at quitting even after controlling for demographic variables, treatment factors, self-report and biochemical indices of dependence, and other theoretically related variables such as negative affect and perceived stress. Expectancies predicted these important outcomes despite being largely unrelated to baseline measures of nicotine dependence. These results suggest that expectancies possess unique predictive validity and that they are not redundant with measures of drug use (Vuchinich & Tucker, 1988), negative affect, or stress. This conclusion, of course, rests on the assumption that our measures of prior drug use, negative affect, and perceived stress were reliable and valid.

Moreover, the results provide evidence for the discriminant validity of specific expectancy factors. For example, negative reinforcement expectancies were a consistent predictor of cessation success, but positive reinforcement expectancies were not. Negative reinforcement expectancies were more strongly

sation success may be masked by inclusion of the other expectancy scales. However, the predictive relations between each scale and cessation success were virtually identical when each expectancy scale was entered individually rather than as part of the set of expectancy scales, providing evidence that a lack of predictive power of one scale could not be attributed to the regression of the dependent variable on the other scales.

related to baseline negative affect and perceived stress than were the other expectancy scales. As would be expected given this finding, negative reinforcement expectancies appeared to have the largest amount of overlap with negative affect and perceived stress when predicting postcessation measures in relation to the other expectancy dimensions. These results are congruent with recent models of addiction (Baker et al., 1987) and with research on alcohol use indicating that tension reduction expectancies are better predictors of relapse and length of abstinence than are other expectancy scales (Brown, 1985; Rather & Sherman, 1989). It is important to note that despite the fact that there was overlap among negative affect, perceived stress, and negative reinforcement expectancies, negative reinforcement expectancies continued to predict withdrawal indices and cessation success even after controlling for these variables.

Furthermore, expectancies of positive outcomes (Positive Reinforcement, Negative Reinforcement, and Appetite–Weight Control) predicted withdrawal severity, and negative outcome expectancies (Negative Consequences) did not. This is consistent with suggestions that withdrawal may be related to the loss of a reinforcer (Falk, 1981; Hatsukami, Hughes, & Pickens, 1985; Hughes & Hatsukami, 1986). Importantly, there may be a theoretical distinction between positive and negative reinforcement with respect to their prediction of withdrawal severity and the likelihood of smoking. The expected loss of either positive reinforcement (pleasure) or negative reinforcement (negative affect reduction) appears to result in an increase in negative affect and withdrawal severity, with little difference between the reinforcement scales in regard to the strength of their predictive relations. On the other hand, negative reinforcement expectancies may be better predictors of smoking likelihood because the increase in negative affect after quitting may act as a setting event for smoking such that negative reinforcement expectancies are more salient and accessible than are positive reinforcement expectancies. Thus, expectancies of reinforcement loss of any type may be related to the severity of withdrawal, but negative reinforcement expectancies may be more predictive of relapse.

Despite being unrelated to withdrawal, expectancies of the negative consequences of smoking predicted abstinence in the first week after quitting, congruent with models of behavior change that posit that such change involves appraisal of anticipated outcomes (e.g., the health beliefs model or the theory of reasoned action; Fishbein, 1982; Weinstein, 1993). In summary, specific expectancy factors appear to be differentially related to important outcomes in theoretically meaningful ways.

Several findings deserve further comment. First, negative consequences expectancies predicted cessation success during the first week after quitting but not at end of treatment. It may be that immediately on quitting, expectancies regarding the aspects of smoking that are disliked or that motivated the quit attempt are particularly salient and readily accessible. With the passage of time, expectancies regarding the negative effects of smoking may be less salient and readily accessible and less influential in relation to positive expectancies of smoking. The finding that negative reinforcement expectancies were more strongly related to abstinence at the end of treatment than to abstinence at the end of the first week would seem to support this interpretation—that is, positive outcome expectancies may be more influential, and negative outcome expectancies less influential—as length of abstinence increases.

Second, Cooper et al. (1992) found that expectancies were better predictors of alcohol use for men than for women. In our study, gender did not consistently interact with any of the expectancy scales (only 1 of the 16 interactions involving gender and expectancies was significant). Therefore, the precise relationship between gender and expectancies is unclear.

Third, several studies have found that expectancies interact with negative affect and stress in concordance with a stressor vulnerability model (Cooper et al., 1992; McKirnan & Peterson, 1988). We did not replicate these findings because only 1 of the 16 interactions of expectancies with negative affect or perceived stress was significant when predicting cessation success. However, there are a number of major differences between the present study and previous studies that might be responsible for this discrepancy. The present study prospectively predicted smoking outcome variables among a relatively homogenous population of dependent smokers, whereas previous studies have examined concurrent measures of alcohol consumption in populations with heterogenous use patterns (Cooper et al., 1992; McKirnan & Peterson, 1988). In addition, each of the studies used a different measure of stress. Thus, differences in the study designs, assessment instruments, outcome variables, drugs being examined, and populations under study could account for discrepant findings with regard to a stressor vulnerability model.

Fourth, expectancies were largely unrelated to purported measures of dependence among addicted adult smokers. As discussed earlier, this was expected and may be a result of a restriction in range in both expectancy scores and dependence measures. However, negative reinforcement expectancies predicted cessation success after controlling for dependence measures and, in fact, were equivalent or superior to traditional dependence measures in predicting cessation success. After controlling for dependence, the three positive outcome expectancy scales predicted withdrawal severity as well. Assuming that withdrawal severity and difficulty quitting smoking are valid manifestations of dependence, an intriguing possibility is that a smoker's expectancies regarding the effects of smoking provide a more sensitive index of "dependence" than do traditional self-report measures or biochemical assays. It should be noted that dependence may be difficult to define and that these measures constitute only a few of many potential measures of dependence.

Finally, the positive association of appetite–weight control expectancies with cessation success at the end of treatment was surprising. Unfortunately, we were unable to clarify this relationship even when considering possible associations with baseline body weight, body mass index, weight gain during treatment, gender, and patch status. Replication of this effect along with careful assessment of possible mediating factors will be important in future research.

Our results have important implications for expectancy research and theory, particularly to the extent that the results may be generalized to other drugs and addict populations. One implication is that expectancies appear to be valid predictors of drug withdrawal symptoms and of the distress occasioned by abstinence. Expectancies also show considerable promise as predictors of cessation success. These relations do not appear to

reflect nonrecursive effects of cessation success or failure; the prospective nature of our research protects against this possibility. Nor do the results appear to be epiphenomena attributable to conceptually similar affective or psychopharmacological constructs; predictive relations remained significant even after controlling for negative affect, stress, and dependence measures. Of course, it is important to note the modest size of some of the predictive relations. This research also supports other recent data suggesting that the positive outcome expectancies of drug effects should be assessed using multiple dimensions (Leigh & Stacy, 1993; Stacy, MacKinnon, & Pentz, 1993). The scales of the SCQ showed sufficient discriminant validity to support additional research examining the construct validity of specific expectancy scales. Last, our results indicate that the SCQ appears to be a valid and reliable instrument when used with dependent smokers. The SCQ had a satisfactory factor structure and good internal consistency, and there was evidence for the predictive and discriminant validity of individual scales in a prospective study.

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